temperature superconductor that comprises a pair of charge supply layers constituted by an upper and a lower surface of a unit superconductor lattice having each of a portion of Cu atoms in these surfaces substituted with polyvalent, reducible ions and having these substitutional ions exclusively and selectively reduced, and a superconducting layer as a layer other than those upper and lower surfaces.

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IN THE CLAIMS:

Please cancel claims 1-21 without prejudice or disclaimer and add new claims 22-44 as follows:

22. A selective reduction type high temperature superconductor, characterized in that the high temperature superconductor has a unit cell that comprises a pair of charge supply layers formed by an upper and a lower surface thereof having each of a portion of Cu atoms substituted with a selectively reducible atom, and superconducting layers as layers other than said charge supply layers, wherein said charge supply layers have said selectively reduced atoms selectively reduced.

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23. A selective reduction type high temperature superconductor as set forth in claim 23, characterized in that selective reduction as aforesaid of said high temperature superconductor forms in said superconducting layers of the high temperature superconductor a first and a second region which are doped overly and doped optimally, respectively, with superconducting carriers.

24. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that selective reduction as aforesaid of said high temperature superconductor maintains a superconducting carrier concentration in said superconducting layers in toto as doped overly or as doped optimally with the superconducting carriers.

25. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that said superconducting layers of said high temperature superconductor have an upper and a lower surface constituted by a CuO2 surface of 5-coordination and a surface other than the upper and lower constituted by a CuO2 surface of 4-coordination.

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26. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that it is made of a (Cu, M) family high temperature superconducting material that can be described by composition formula:

$$Cu_{1-x}M_x(Ba_{1-y},Sr_y)_2Ca_{1-z}L_z)_{n-1}Cu_nO_{2n+4-w}$$

where M represents ions of one or more polyvalent metallic elements selected from the class which consists of Tl, Bi, Pb, In, Ga, Sn, Ti, V, Cr, Mn, Fe, Co, Ni, Zr, Nb, Mo, W, Re and Os; L represents one or more elements selected from the class which consists of Mg and alkaline metallic elements; $0 \le x \le 1.0$; $0 \le y \le 1$; $0 \le z \le 1$; $0 \le w \le 4$; and $1 \le n \le 16$.

27. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that it is made of a (Cu, Tl) family high temperature superconducting material that can be described by composition formula:

$$Cu_{1-x}Tl_x(Ba_{1-y}Sr_y)_2Ca_{1-z}L_z)_{n-1}Cu_nO_{2n+4-w}$$

where L represents one or more elements selected from the class which consists of Mg and alkaline metallic elements; $0 \leq x \leq 1.0$; $0 \leq y \leq 1$; $0 \leq z \leq 1$; $0 \leq w \leq 4$; and$\leq 1$ $n \leq 16$.

28. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that it is made of a (Cu, Tl) family high temperature superconducting material that can be described by composition formula:

$$Cu_{1-x}Tl_x(Ba_{1-y}Sr_y)_2(Ca_{1-z}L_z)_2Cu_3O_{10-w}$$

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where L represents one or more elements selected from the class which consists of Mg and alkaline metallic elements; $0 \leq x \leq 1.0$; $0 \leq y \leq 1$; $0 \leq z \leq 1$; and $0 \leq w \leq 4$.

29. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that it is made of a high temperature superconducting material that can be described by composition formula:

$$Cu_{1-x}Tl_x(Ba_{1-y}Sr_y)_2(Ca_{1-z}L_z)_3Cu_4O_{12-w}$$

where L represents one or more elements selected from the class which consists of Mg and alkaline metallic elements; $0 \leq x \leq 1$; $0 \leq y \leq 1$; $0 \leq z \leq 1$; and $0 \leq w \leq 4$.

30. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that the concentration of superconducting carriers is adjusted by selective reduction or by varying (increasing or decreasing) oxygen concentration.

31. A selective reduction type high temperature superconductor as set forth in claim 26, characterized in that it is a selectively over-doped type or a selectively optimum-doped type, high temperature superconductor in which n is any one of 3, 4, 5, 6 and 7.

32. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that selective reduction causes said substitutional atoms in a said charge supply layer to receive electrons in their outer shell orbits, thereby providing holes in the CuO2 surface of 5-coordination of a said superconducting layer.

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33. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that it has a superconducting anisotropy of not greater than 10, and a coherence distance of not less than 3 angstroms.

34. A selective reduction type high temperature superconductor as set forth in claim 22 or claim 23, characterized in that said selective reduction transforms its natural superconducting wave function that is of a d-wave to a wave function of a (d + *i*s) wave that has also a property of an s-wave.

35. A method of making a selective reduction type high temperature superconductor, characterized in that it comprises the steps of:

adding an element exhibiting a self-assembling effect and selective reducibility to a raw material of a high temperature superconductor;

using the self-assembling effect of said element to cause a crystal of the high temperature superconductor to grow with a structure in which said element is substituted for a portion of Cu atoms in a charge supply layer of a basic cell of the high temperature superconductor; and

using the selective reducibility of said element to selectively reduce said element in the charge supply layer of the basic cell of said high temperature superconductor crystal.

36. A method of making a selective reduction type high temperature superconductor as set forth in claim 35, characterized in that:

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the step of causing the high temperature superconductor crystal to grow includes the steps of admixing together a precursor of the high temperature superconductor, a chemical compound of said element and a oxidizing and a reducing agent to form a mixture thereof, and heat treating said mixture in a high pressure condition; and

the step of selective reduction comprises heat treating said high temperature superconductor crystal in a reducing atmosphere.

37. A method of making a selective reduction type high temperature superconductor as set forth in claim 36, characterized in that:

said mixture comprises a mixture formed by admixing said precursor represented by composition formula: $Ba_2Ca_2Cu_3O_7$, said element chemical composition constituted by $Tl_2O_3$, said oxidizing agent constituted by AgO or $CaO_2$ and said reducing agent constituted by $Cu_2O$ with a prepared composition: $Cu_{0.5}Tl_{0.5}Ba_2Ca_2Cu_3O_y$;

the step of causing said high temperature superconductor to crystallographically grow includes a heat treatment under a high pressure of 5Gpa at a temperature of 850°C for a period of 2 hours; and

the step of selective reduction includes a heat treatment at a temperature of 400 to 700°C, preferably at 540°C, for a period of 12 hours in a reducing atmosphere in $N_2$;

thereby forming a selective reduction type high temperature superconductor having a CU-1223 structure and represented by composition formula: $(Cu_{1-x}Tl_x)Ba_2Ca_2Cu_3O_y$ where $0 \leq x \leq 1.0$ and $0 \leq y \leq 1$.

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38. A method of making a selective reduction type high temperature superconductor as set forth in claim 36, characterized in that:

the precursor of said high temperature superconductor is a precursor represented by composition formula:

$Cu(Ba_{1-y}Sr_y)_2(Ca_{1-z}L_z)_{n-1}Cu_nO_{2n+4-w}$ where L represents one or more elements selected from the class which consists of Mg and alkaline metallic elements; $0 \leq x \leq 1.0$; $0 \leq y \leq 1$; $0 \leq z \leq 1$; $0 \leq w \leq 4$; and $1 \leq n \leq 16$; and

the chemical compound of said element exhibiting said self-assembling effect and said selective reducibility is a compound containing one or more polyvalent metallic elements selected from the class which consists of Tl, Bi, Pb, In, Ga, Sn, Ti, V, Cr, Mn, Fe, Co, Ni, Zr, Nb, Mo, W, Re and Os;

thereby forming a selective reduction type high temperature superconductor having a Cu-1223 structure and represented by composition formula:

$Cu_{1-x}M_x(Ba_{1-y}Sr_y)_2(Ca_{1-z}L_z)_{n-1}Cu_nO_{2n+4-w}$.

39. A method of making a selective reduction type high temperature superconductor, characterized in that it comprises the steps of:

heat treating in an atmosphere of an element exhibiting a self-assembling effect and a selective reducibility an amorphous film of a high temperature superconductor composition containing said element deposited on a single crystalline substrate;

using the self-assembling effect of said element and an epitaxy effect of said single crystalline substrate to cause a high temperature superconductor to crystallographically grow with a structure having said element substituted for a portion of Cu atoms in a charge supply layer of a basic cell of the high temperature superconductor; and

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using the selective reducibility of said element to selectively reduce said element in the charge supply layer of the basic cell of said high temperature superconductor.

40. A method of making a selective reduction type high temperature superconductor as set forth in claim 39, characterized in that:

the step of causing said high temperature superconductor to crystallographically grow includes the steps of preparing a mixture pellet containing said element and a pellet for adjusting the concentration of said element, depositing said amorphous film on said single crystalline substrate by spattering a target of a high temperature superconductor composition containing said element, and heat treating said mixture pellet, said concentration adjustment pellet and said amorphous film commonly in a closed container; and

the step of selective reduction includes heat treating said high temperature superconductor crystal in a reducing atmosphere.

41. A method of making a selective reduction type high temperature superconductor as set forth in claim 40, characterized in that:

said mixture pellet is a mixture of a high temperature superconductor precursor whose constituent elements are Cu, Ba, Ca and O with $Tl_2O_3$ as a chemical compound of said self-assembling effect and selective reducibility exhibiting element in a composition range expressed by composition formula: $Cu_{1-x}Tl_xBa_2Ca_3Cu_4O_y$ where x = 0.25 to 0.5 and formed by pressing;

said concentration adjustment pellet is a thallium concentration adjustment pellet formed by heat treating a said mixture pellet for a period of 1 hour;

said amorphous film is obtained by spattering a sintered target of a composition expressed by composition formula: $TlBaSrCa_2Cu_3O_y$ to deposit the composition on a $SrTiO_3$ substrate;

the heat treatment in said closed container is performed at a temperature of 860 to 900 for a period of 30 to 90 minutes;

the step of selective reduction include a heat treatment effected at a temperature of 500°C for a period of 30 minutes in a reducing atmosphere of low pressure oxygen gas at a pressure not in excess of 1 atm; and

thereby forming a selective reduction type high temperature superconductor having a Cu-1223 structure and expressed by composition formula:

$(Cu_{1-x}Tl_x)(BaSr)_2Ca_2Cu_3O_y$ where x = 0.4 to 0.8.

42. A method of making a selective reduction type high temperature superconductor as set forth in claim 40, characterized in that:

said mixture pellet is a mixture of a high temperature superconductor precursor whose constituent elements are Cu, Ba, Ca and O with a chemical compound containing one or more of self-assembling effect and selective reducibility exhibiting elements as aforesaid M selected from the class which consists of Tl, Bi, Pb, In, Ga, Sn, Ti, V, Cr, Mn, Fe, Co, Ni, Zr, Nb, Mo, W, Re and Os in a composition range expressed by composition formula: $Cu_{1-x}M_xBa_2Ca_3Cu_4O_y$ where x = 0.25 to 0.5 and formed by pressing;

said concentration adjustment pellet comprises an M concentration adjustment pellet formed by heat treating a said mixture pellet for a period of 1 hour;

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said target is a sintered target of a composition expressed by composition formula: $TlBaSrCa_2Cu_3O_y$; and

thereby forming a (Cu, M) family, selective reduction type high temperature superconductor having a Cu-1223 structure and expressed by composition formula:

$Cu_{1-x}M_x(Ba_{1-y}Sr_y)_2(Ca_{1-z}L_z)_{n-1}Cu_nO_{2n+4-w}$.

43. A method of making a selective reduction type high temperature superconductor as set forth in claim 40, characterized in that:

said mixture pellet is a mixture of a high temperature superconductor precursor whose constituent elements are Cu, Ba, Ca and O with $Tl_2O_3$ as a chemical compound of said self-assembling effect and selective reducibility exhibiting element in a composition range expressed by composition formula: $Cu_{1-x}Tl_xBa_2Ca_3Cu_4O_y$ where x = 0.25 to 0.5 and formed by pressing;

said concentration adjustment pellet is a thallium concentration adjustment pellet formed by heat treating a said mixture pellet for a period of 1 hour;

said amorphous film is obtained by spattering a sintered target of a composition expressed by composition formula: $Cu_{1-x}Tl_xBa_2Ca_3Cu_4O_y$ to deposit the composition on a $SrTiO_3$ substrate;

the heat treatment in said closed container is performed at a temperature of 880 to 920°C for a period of 60 minutes;

the step of selective reduction include a heat treatment effected at a temperature of 450 to 500°C for a period of 30 minutes in a reducing atmosphere of low pressure oxygen gas at a pressure not in excess of 1 atm; and

thereby forming a selective reduction type high temperature superconductor having a Cu-1234 structure and expressed by composition formula: $Cu_{1-x}Tl_xBa_2Ca_3Cu_4O_y$.

44. A method of making a selective reduction type high temperature superconductor as set forth in claim 40, characterized in that:

said mixture pellet is a mixture of a high temperature superconductor precursor whose constituent elements are Cu, Ba, Ca and O with $Tl_2O_3$ as a chemical compound of said self-assembling effect and selective reducibility exhibiting element in a composition range expressed by composition formula: $Cu_{1-x}Tl_xBa_2Ca_3Cu_4O_y$ where $x = 0.25$ to $0.5$ and formed by pressing;

said concentration adjustment pellet is a thallium concentration adjustment pellet formed by heat treating a said mixture pellet for a period of 1 hour;

said amorphous film is obtained by spattering a sintered target of a composition expressed by composition formula: $Cu_{1-x}Tl_x(Ba_{1-y}Sr_y)_2(Ca_{1-z}L_z)_3Cu_4O_{12-w}$ to deposit the composition on a $SrTiO_3$

substrate; and

A2 thereby forming a selective reduction type high temperature superconductor having a Cu-1234 structure and expressed by composition formula:

$Cu_{1-x}Tl_x(Ba_{1-y}Sr_y)_2Ca_3Cu_4O_y$ where $0 \leq x \leq 1.0$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, and $0 \leq w \leq 4$.